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RESEARCH AND DEVELOPMENT BOARD
Washington, D C

GM 36/198 (COVER)

15 December 1950

MEMORANDUM FOR EXECUTIVE SECRETARY, RESEARCH AND DEVELOPMENT BOARD

SUBJECT: 1951 Program Guidance Report in the Field of Guided Missiles.

Attached: GM 36/198 - Program Guidance in the Field of Guided Missiles, dtd 8 December 1950

Program Guidance in the Field of Guided Missiles, GM 36/198, forwarded herewith was approved by the Committee on Guided Missiles at its 29th Meeting on 6, 7 and 8 December 1950.

FRED A. DARWIN
Executive Director
Committee on Guided Missiles

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GM 36/198
Item 11-GM 3/29

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GM 36/198

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COMMITTEE ON GUIDED MISSILES
RESEARCH AND DEVELOPMENT BOARD

PROGRAM GUIDANCE IN THE FIELD OF GUIDED MISSILES

8 December 1950

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COMMITTEE ON GUIDED MISSILES
RESEARCH AND DEVELOPMENT BOARD
Washington 25, D. C.

8 December 1950

PROGRAM GUIDANCE IN THE FIELD OF GUIDED MISSILES

1. INTRODUCTION

1.1 It is the purpose of this report to provide guidance for future program planning in the field of guided missiles. While the program guidance supplied earlier in the year in GM 36/95 is still completely applicable to the program as a whole, the advent of the Korean situation, with the subsequent increase in financial support of military research and development, requires that the added funds accruing to the guided missiles program be applied so as to achieve the following objectives:

1.1.1 To hasten the prototyping of new equipment for service test where substantial mobilization procurement is contemplated.

1.1.2 To complete development on urgently needed and well advanced items.

1.1.3 To accelerate the earlier stages of development, and applied research in especially critical areas.

2. GENERAL GUIDANCE

2.1 Major emphasis should be placed on completing the prototyping of those missiles which are now in an advanced state of development and to which the Joint Chiefs of Staff have also assigned a high priority. The achievement of successful prototypes will require increased emphasis on product engineering and component reliability.

2.2 With the freeing of funds and the advancement of desired completion dates, a serious shortage of competent engineers is in prospect, requiring diversion of engineers from duplicate or insurance approaches from low priority categories, and from non-defense research and development, to the selected weapons. The common denominator of missile projects should be considered in terms of operational requirements and engineering effort rather than in terms of funds.

2.3 Certain new projects should be initiated to fill gaps in the program which have become increasingly significant in view of the current world situation.

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2.4 The support of the Technical Objectives in the field of guided missiles should be revised as follows (the recommended changes are related to the FY 1950 obligations and are in priority order):

2.4.1 AD-7- The support of this Technical Objective should be increased 140%. This will accomplish a reduction in the time scale in this highest-priority category and permit the initiation of projects to fill serious gaps; namely, a long-range surface-to-air missile, a homing-all-the-way missile, and studies of special warheads for use against aircraft.

2.4.2 AD-14 - The support of this Technical Objective should be increased 100%. This will accomplish a reduction in time scale of three missiles in this high-priority (second) category.

2.4.3 SA-13- The support of this Technical Objective should be increased 140% to permit completion of a prototype missile much earlier than the previous level of support would have permitted.

2.4.4 LC-16 - The support of this Technical Objective should be increased 300%. This will permit accelerated development of prototypes of high-priority (fifth) short-range surface-to-surface missiles, initiation of development of a short-range precision missile and the study of an anti-tank missile.

2.4.5 SC-16 - The support of this Technical Objective should be increased 20%. This will insure the early availability of a prototype missile and permit development which will improve the performance of an available interim missile.

2.4.6 CA-14 - The support of this Technical Objective should be increased 30%, in order to accelerate the availability of a prototype of the missile in this Technical Objective.

2.4.7 SA-11- The support of this Technical Objective should be increased 40%. This added support should be used to accelerate the guidance developments in the long-range categories, which is the limiting factor in the development of these missiles.

2.4.8 AS-8 - The support of this Technical Objective should be increased 70%. Such an increase will not involve a relatively large amount of funds since the current effort is low. While this Technical Objective carries a relatively low priority, such added support will hasten the availability of the only anti-submarine missile being developed and permit development of an air-launched version.

2.4.9 SR-10 - Supporting research should also receive increased emphasis, particularly along the lines which may be expected to improve

reliability, reproducibility and predictability of performance of the various guided missiles and components employed in them. The effort on such general problems should be increased at least 100%.

3. GUIDANCE BY TECHNICAL FIELDS

3.1 Attention is again invited to the guidance contained in GM 36/95, and in RDB 194/30. The guidance in the various technical fields which follows is intended to supplement but not supplant that contained therein. For added information on the points discussed, the military departments are referred to the detailed Panel Reports.

3.2 Guidance and Control

3.2.1 Missile guidance systems are reaching the stage where selective elimination and consolidation of projects can and should be accelerated over the coming two years, with it now becoming feasible to evaluate operative systems comparatively.

3.2.2 The trend in guidance over the forthcoming few years should be in the direction of increased tying-in of the guidance systems of selected missiles with the expected operational environment of those missiles. Considerable emphasis will be required on reliability in the field, and on ease of operation, maintenance, and checkout, with minimum demands made on the training of operating personnel. Reliability of connections and of components, especially tubes, relays and connectors requires particular consideration. Countermeasures, both active and passive, should be anticipated and provided for in the guidance systems. The relationship of warhead effectiveness and guidance accuracy must be clearly determined. Miniaturization techniques developed for some missiles without sacrifice of reliability should be exploited by all contractors to whose missiles they are applicable. The capabilities and limitations of types of secondary power sources should be determined as soon as practicable and possibilities of standardization be considered. Information as to classified products and techniques that have been developed suitable for missile use should be more completely reported and distributed. Studies of the nature of "noise" in missile systems should be pursued vigorously toward the end of reducing inaccuracies from this source. Care should be taken to see that adequate information will be available upon which guidance can be based, e.g., location of submarines for Rigel-Regulus and location of targets for surface-to-surface missiles. Guidance and fuzing should be closely integrated.

3.2.3 In the field of guidance against air targets, the magnitude of several problems is becoming more obvious as missiles come into the guidance test flight stage. One of the most important of these is the problem of attacking multiple targets. This is a condition which operationally can be expected a substantial percentage of the time. Range discrimination is being exploited nearly to the maximum extent, so that the

addition of greatly increased angular discrimination is required. The use of homing devices is indicated, with an attendant problem of target acquisition. The applicability of infrared seekers appears to be that of auxiliary homing devices. The need for a long-range surface-to-air missile poses many guidance problems requiring considerable effort.

3.2.4 Adequate traffic handling constitutes another problem for which a sufficient solution does not exist today. Homing-all-the-way offers attractive possibilities in this regard, and it should be studied further with this end in view.

3.2.5 Targets coming in low over both land and sea, in the first case medium bombers and in the second case torpedo bombers or guided missiles, may be expected. A solution to the problem of attacking these targets with guided missiles, with the attendant guidance problems of ground clutter, altitude and sea return, and ground reflections should be found. Some possible answers in the case of targets over sea can be seen. Evaluation of the numberous homing device projects in terms of those problems should be undertaken and work discontinued on those which will not be used.

3.2.6 In the field of long-range surface-to-surface guidance, continuing consolidation of guidance projects looking toward one inertial or celestial system should be effected. A decision should be made as to what compromise in guidance accuracy and other performance can be made in the interests of earlier availability of an operating system, with concurrent evaluation of the operational limitations of the several types of celestial and inertial systems. The remaining projects should be reduced to component improvement, with the possible exception of a moderate-accuracy system if an operational requirement for the latter is established.

3.2.7 As missiles approach the production stage, coordination of frequency allocations and determination of future frequency requirements (both for range instrumentation and for operational weapons systems) become of increasing importance, necessitating early resolution of these requirements with respect to each other and with respect to those of other radiating equipment which may cause interference.

3.3 Aerodynamics and Structures

3.3.1 Aerodynamic progress has been such that there are no problems associated with major guided missile projects for which a usable solution within the next two years appears unlikely. Refinement of design and attempts at better understanding of underlying causes of problems must of necessity continue indefinitely. Outstanding current problems which, of course, vary in importance with the performance required of the individual missiles, are transonic stability and control, roll due to combined pitch and yaw, roll due to vortex shedding from long bodies operating at high angles of attack, development of efficient air induction systems for

air-breathing engines, and aerodynamic heating and heat transfer at the higher Mach numbers. A much more thorough knowledge of hypersonic phenomena will be necessary for the design of long-range missiles approaching ballistic type trajectories. In the supersonic regime presently available and authorized facilities should adequately handle aerodynamic development at a rate consistent with development of the other components of the missiles.

3.3.2 Structures problems can and have been solved by extensions of conventional techniques, but this is believed to be an unhealthy situation resulting in inefficient missile structures. Additional emphasis should be given now to research projects which will provide the future necessary information when structural refinement of workable missiles is required. Typical information needed relates to rational design criteria, properties of new materials, load analysis for missile-booster configuration and stress analysis methods for loading and temperature conditions of supersonic missiles, particularly those with internal propulsive systems.

3.4 Propulsion and Fuels

3.4.1 The following deficiencies have been noted in the field of propulsion and fuels:

3.4.1.1 Insufficient investigation of the factors causing combustion instability in liquid rocket motors, and methods for overcoming that phenomena.

3.4.1.2 Insufficient investigation of means for suppressing the flame and smoke issuing from liquid propellant rocket motors.

3.4.2 In the field of liquid propellant rockets, it is recommended that continued and accelerated investigation of the combustion process in rocket motors be made especially toward determining the factors affecting combustion stability and ignition delay. Continued support of basic studies on heat transfer, materials, handling and storage of propellants, and pressurizing of propellants is necessary to obtain fundamental design data for liquid rocket motors. Developmental effort should be continued on those parameters affecting rocket engine performance and on instrumentation for operation and flight test of rocket engines. Attention is directed to the need for continued development of improved gas generating systems for direct pressurizing or turbopumping units.

3.4.3 In the field of ramjets, it is recommended that the fundamental studies directed toward determining the effects of velocity, temperature, and pressure on combustion and flame stabilization be continued. Additional effort to standardize performance parameters in order to permit valid comparisons of different engines is also required. The need for basic design data on the fundamentals affecting air intake phenomena should be noted. It is recommended that the support of projects leading to adequate

fuel injection systems, fuel metering, and control systems be continued to provide a balanced program. Further studies on the application of variable area exhausts and the use of high energy fuels and/or auxiliary oxidizers to improve the overall performance of ramjet engines should be supported.

3.4.4 It is further recommended that fundamental experimental studies of two-dimensional ramjets should be supported to enable final conclusions to be reached. Also, a continuing small measure of support should be given to methods to improve the performance and reliability of the existing pulsejet engines.

3.4.5 The development of ramjet engines and liquid propellant rocket engines other than those for the missiles approved by the Committee on Guided Missiles should continue to receive adequate support in order that new ideas in propulsion and reliable design data for future engines can be accumulated. Basic research on ramjet engines and liquid rocket motors should continue to receive sufficient priority to guarantee that a reasonable amount of work will proceed.

3.5 Launching and Handling

3.5.1 The development of tactical launching and handling systems, especially for surface-to-air missiles, has become an important problem in the launching of guided missiles. In the case of NIKE and TERRIER, the elements of this system have been established and are actively under development; in the case of TERRIER, an automatic trainable and elevatable launcher has been produced and successfully used in missile firings.

3.5.2 Developments in boosters during the period have produced significant advances in the application of new propellants, production of lightweight efficient units, extension of safe firing limits and improvement in reliability. The following recommendations are made to emphasize the principal problems requiring attention.

3.5.2.1 In the field of solid propellant booster development work aimed at extension of performance limits, increase in reliability, and investigation of new techniques should be supported strongly. Developments in techniques for inspecting large propellant grains for physical faults have been disappointingly meager, and additional emphasis is urged on this problem.

3.5.2.2 The various methods available for minimizing damage from falling booster cases should be evaluated by the Army, to establish realistic requirements and to form the basis of a systematic program. Work on fragmentation should in any case be supported on a larger scale to yield definitive results at the earliest opportunity.

3.5.2.3 Test launchings of air-to-air missiles from aircraft should be continued to assess any problems associated with blast and flash which may arise in such systems.

3.5.2.4 Support should be given to immediate establishment of pilot production facilities for casting and curing double-base propellant charges, and firm plans should be formulated for construction of large scale production facilities in time to meet time scales of the missile projects concerned.

3.5.3 In general, estimates of component availability are in line with requirements, except for some long-term projects where component development has not been initiated. However, it appears that missile design is in some cases still fluid, as exemplified by initiation of several new booster and sustainer developments this year to meet increased performance requirements.

3.5.4 The co-ordination of effort in this field continues to be good. No cases of unjustifiable duplication are evident.

3.6 Warheads and Fuzes

3.6.1 The major deficiency in warheads, fuzes, and damage evaluation for guided missiles is the inadequacy of present methods and test schedules for evaluating design performance. The cost of the missiles, the time for completion of each separate test, and the lack of good substitute test methods combine to produce a deficiency which is likely to vitiate all attempts at performance testing. Realization of this condition resulted from the past year's development effort and from the definition of test schedules.

3.6.2 A serious deficiency continues to exist with respect to support for damage evaluation. Much basic design data, which should be at hand to support warhead and fuze designs, do not exist. Extreme difficulty is being experienced in attracting competent personnel under existing conditions.

RECOMMENDATIONS:

3.6.3 Maintenance of at least current level support of fuze and warhead research, and heavy increase of damage evaluation research, specifically:

3.6.3.1 In warheads, research on new explosives, and methods of detonation, basic design parameters for blast, fragmentation, penetration warheads, shaped charges, and mother-daughter warheads.

3.6.3.2 In fuzes, research on new methods of obtaining proximity action, and components and plastics for high-temperature operation, and for operation under heavy vibration.

3.6.3.3 Aircraft and missile damage trials of various types, with emphasis on tougher targets, rod warheads, and guided missiles warhead design theories; ship and submarine damage trials, and related

theory; damage to ground targets by fire, shock waves, and other forms of damage.

3.7 Test Range Procedures and Instrumentation

3.7.1 In general, Range Instrumentation is proceeding in an orderly manner with no unwarranted duplication.

3.7.2 Work in the field of Optical Instrumentation is progressing but the instrumentation available is not entirely satisfactory. Continued development and modification of optical devices by the individual ranges are advisable.

3.7.3 In the field of Electronic Trajectory Instrumentation, the main problem is the evaluation of propagation effects. Many systems are under test, under development, or under consideration. The competitive duplication is healthy but comparative evaluations of the systems are needed.

3.7.4 In the field of Telemetering to fill needs not covered by the standard FM-FM telemeter, the extension of standardization planning into other telemetering systems is under consideration.

3.7.5 In the field of Data Reduction, there has been a worthwhile trend toward development of interim reduction techniques and conversion devices. Many new problems attendant to automatic data reduction are being given consideration.

3.7.6 The Radio Frequency Requirements for the various phases of Guided Missile work and certain other closely related work have not been given full co-ordinated consideration.

3.7.7 Serious deficiencies exist in the field of Intercept Instrumentation and development and testing of techniques should be stressed.

3.7.8 The possibility of achieving better range equipment through standardization of timing [illegible] used on the Ranges is thought worthy of consideration.

RECOMMENDATIONS:

3.7.9 More stress should be placed on the development and comparative testing of the various CW systems.

3.7.10 Studies at the Ranges of propagation effects should be stressed.

3.7.11 A preliminary study should be made of the trajectory data system proposed by Dr. Page of NRL and a report prepared giving preliminary basic information.

3.7.12 Work on the standardization of telemetering systems should be continued. Development should be carried on of a system similar to the present Pulse Width - FM, with the Army suggested as co-ordinating agency.

3.7.13 Development and testing of intercept instrumentation should be heavily stressed.

3.7.14 Consideration should be given by the Ranges to standardization of timing signals.

3.7.15 Increased effort to provide adequate beacons for missile tracking aids is required.

3.8 Test and Training Equipment

3.8.1 In this field, there still seems to be a lack of consideration within the Departments of the desirability of developing operational test and training equipment concurrently with the missile as well as an insufficient amount of emphasis toward this end.

3.8.2 The interchange of information among contractors regarding progress in this field, while improved, is still unsatisfactory.

3.8.3 Lack of adequately trained personnel, both civilian and military, continues to be a cause of concern. Increased efforts by the Departments to overcome this problem is advocated.

3.8.4 Recommendation is made also that early consideration be given to requirements for suitable installations equipped with adequate facilities for the training of tactical guided missile units within the time scale indicated by the Guided Missiles Committee Technical Estimates.

3.9 Target Drones

3.9.1 With the exception of the XQ-2 high speed (500 knots) target drone, current developments on target drones will be completed in FY 1952. The XQ-2 development will be completed by the beginning of FY 1953. No development of a supersonic target is in progress. However, the Navy has completed a study on which such a development could be based.

3.9.2 Current unit costs of target drones are too high due primarily to unnecessarily complicated design and the use of specifications based on piloted aircraft experience. Corrective action should be taken.

3.9.3 There is a need for the establishment of long-term military requirements to permit timely development of adequate target drones. Where possible and practical, the use of operational obsolescent, and obsolete guided missiles for targets should be given continued consideration by the Military Departments.

3.9.4 Development of new and cheaper methods of launching are required. Also, the development of equipment and techniques necessary to permit operation of two (2) or more target drones in formation are required.

3.9.5 Emphasis should be placed on the investigation of all possible means of non-destructive use of drones as guided missile targets. In particular, continuing emphasis should be placed on the development of firing error indicators.

3.10 Countermeasures

3.10.1 Although the total effort on countermeasures against guided missiles, including vulnerability determinations, is small, general interest in the subject is increasing, and the program appears to be in the process of expanding. The present shortage of trained technical personnel will probably present the greatest obstacle to an orderly expansion.

3.10.2 Information on guided missile activity in foreign countries particularly those behind the Iron Curtain would be invaluable to the countermeasures program. For lack of this information and because of the current international situation it was necessary to recommend countermeasures projects against our own guided missiles which is an inefficient way of obtaining the best potential defense against possible enemy guided missiles.

It is recommended that:

3.10.3 An extended test program be initiated for countermeasures against and vulnerability of the types of proximity fuzes that may be used in missiles.

3.10.4 Existing projects on electrostatic, acoustic, infrared, etc., fuze countermeasures be implemented with funds and programs to develop countermeasures.

3.10.5 A study be initiated to determine whether fuzes for special warheads may be jammed in such a way as to prevent operation as well as causing pre-functioning.

3.10.6 The study of unique technical characteristics of launching sites in all its phases be continued in high priority.

3.10.7 The field of infrared countermeasures be further expanded and accelerated.

3.10.8 A project be initiated to continue the study to determine the operating characteristics of possible missile fuzes, viz., normal, desired pre-function range, missile configuration as affecting antenna

design, etc., and a project be initiated to investigate possible fuze frequencies, signal characteristics, and jamming susceptibility, resulting from the first study, leading to the determination of specifications for guided missile countermeasures. The program should be established in all three Services, each Service being responsible for the study of such missile fuzes as will be used against targets the defense of which that Service is responsible.

3.10.9 Countermeasures projects be initiated for each of the major guided missiles.

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MEMORANDUM FOR DEFENSE TECHNICAL INFORMATION CENTER
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MAR 3 1 '16

SUBJECT: OSD MDR Cases 11-M-1010, -1011, -1013, -1014, -1015, and -1026

We have reviewed the attached documents and have no objection to declassification in full. The information you requested is provided in the table below:

OSD Case Number 11-M-	Current Controlling Agency	Current Controlling Official	Current Distribution Control Statement	Current Overall Classification Level	Current Downgrading Instructions	Current Declass. Instructions
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1013	WHS	OSD Records Official	A Release Unlimited	C	N/A	N/A
1014	WHS	OSD Records Official	A Release Unlimited	C	N/A	N/A
1015	WHS	OSD Records Official	A Release Unlimited	S	N/A	N/A
1026	WHS	OSD Records Official	A Release Unlimited	S	N/A	N/A

If you have any questions, contact me by phone at 703-696-2197 or by e-mail at storer.robert@whs.mil or robert.storer@whs.smil.mil.

Robert Storer

Enclosures:
1. DTIC request
3. Six documents

Robert Storer
Chief, Records and Declassification Division

[redacted]
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